Phytosterol

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Phytosterols (also called **plant sterols**) are a group of steroid alcohols, phytochemicals naturally occurring in plants. Phytosterols occur naturally in small quantities in vegetable oils, especially sea buckthorn oil (1640 mg/100g oil),[1] corn oil (968 mg/100g),[2] and soybean oil (327 mg/100g oil).[3] One such phytosterol complex, isolated from vegetable oil, is cholestatin, composed of campesterol, stigmasterol, and brassicasterol, and is marketed as a dietary supplement. They are white powders with mild, characteristic odor, insoluble in water and soluble in alcohols. They have applications in medicine and cosmetics and as a food additive taken to lower cholesterol.

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Plant structure

Plants contain a range of phytosterols. They act as a structural component in the cell membrane, a role which in mammalian cells is played by cholesterol.

Uses

As a food additive

As a food ingredient or additive, phytosterols have cholesterol-lowering properties (reducing cholesterol absorption in intestines).[4]

Dispute

The status of the safety and efficacy of the use of phytosterols as a food-additive is disputed. While recent studies suggest that dietary supplementation of plant sterols can have a leveling effect on human cholesterol, some studies would appear to indicate that they are hard on the heart, arteries and blood-vessels, meaning, depending on intake, they may do more damage to the circulatory system than they alleviate.

Potential benefits

The FDA has approved the following claim for phytosterols: "Foods containing at least 0.4 gram per serving of plant sterols, eaten twice a day with meals for a daily total intake of at least 0.8 gram, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease."*

To date, more than 20 clinical studies on the effects of phytosterols on cholesterol have been conducted. One study published in Food Technology indicated that consuming two grams of phytosterols daily could slash the risk of heart disease by 25% (Hicks 2001). Another study published in the American Journal of Clinical Nutrition revealed that phytosterols interfered with cholesterol absorption by 33% to 42% (Mattson 1982).

Reference: http://www.medicalnewstoday.com/articles/27981.php

Sterols can reduce cholesterol in human subjects by 10% to 15%.[5]

The mechanism behind phytosterols and the lowering of cholesterol occurs as follows: the incorporation of cholesterol into micelles in the gastrointestinal tract is inhibited, decreasing the overall amount of cholesterol absorbed (see cholesterol absorption inhibitor). This may in turn help to control body total cholesterol levels, as well as modify HDL, LDL and TAG levels. Many margarines, butters, breakfast cereals and spreads are now enriched with phytosterols and marketed towards people wishing to lower their cholesterol levels.

Researchers in Uruguay who conducted a small case cohort study suggested an association between dietary sterol intake and decrease risk for the development of gastrointestinal cancers; [6]; however, a subsequent large-scale study from the Netherlands reported that high dietary intake of plant sterols was not associated with a lower risk of colon and rectal cancers.[7]

Potential risks

The main health concerns are atherosclerosis and the vulnerable plaques which produce heart attacks, stroke, and other cardiovascular and cerebrovascular events. It is not overwhelmingly clear that lowering total blood cholesterol levels is by any means is healthy, and there are no large clinical trials which verify the efficacy of phytosterols in reducing heart attack rates as a result of altering cholesterol levels. Furthermore, there is some evidence that phytosterols can promote atherosclerosis, particularly in susceptible individuals.[8] [9]. A 2008 study conducted in Finland showed that sterols can accumulate in heart valves, suggesting that dietary sterols might increase the risk of aortic valve stenosis.[10]

Detection of organic matter

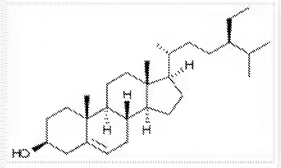
Due to its presence in terrestrial plant matter and only rare occurrence in unicellar algae, β-sitosterol can be used as a biomarker indicating the amount of terrestrially derived organic matter present in a sample. As these sterols are generally insoluble in water, they will partition onto suspended or settled solid matter (e.g. sediments). Due to grain surface area effects, muds will have greater concentrations by weight than sands or coarser grained sediments. To overcome this effect, ratios of individual sterols to total sterol content or cholesterol are usually used to indicate organic matter source.

Detection of adulteration

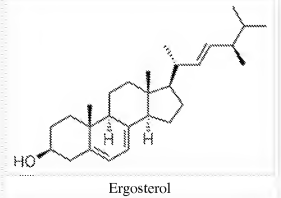
Presence of brassicasterol, together with auxiliary markers α-linolenic acid and erucic acid, is a marker of adulteration of soybean oil and sunflower oil with rapeseed oil. As there is no brassicasterol in sunflower and soybean oil, but its concentration in rapeseed oil is about 1400 mg/kg, the amount of rapeseed oil added can be calculated. [1] (http://www.vupp.cz/envupp/falsificat.htm)

Specific phytosterols

- The uppermost molecule pictured is β-sitosterol.
- By removing carbon 24^2, campesterol is obtained.
- By removing carbons 24^1 and 24^2, cholesterol is obtained.
- Removing a hydrogen from carbons 22 and 23 yields stigmasterol (stigmasta-5,22-dien-3β-ol).
- Removing carbon 24^2 and hydrogens from carbons 22 and 23 yields brassicasterol (ergosta-5,22-dien-3β-ol).
- Further removal of hydrogens from carbons 7 and 8 from brassicasterol yields ergosterol (ergosta-5,7,22-trien-3β-ol). Important: Ergosterol is not a plant sterol. Ergosterol is a component of fungal cell membranes, serving the same function that cholesterol serves in animal cells.



β-Sitosterol



Ergosterol

References

1. ^ Li, Thomas S. C.; Beveridge, Thomas H.J., Drover, John C.G. (1633-1639). "Phytosterol content of sea buckthorn (Hippophae rhamnoides L.) seed oil: Extraction and identification (http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T6R-4JXH3RX-